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NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on March 26th.

The following gentlemen were elected Members of the Society—

MAJOR-GENERAL SIR CHARLES WARREN, G.C.M.G., K.C.B., R.E.

MR. PERCY S. PILCHER.

PROF. G. F. FITZGERALD, F.R.S.

CAPT. G. PHILLIPS, R.E.

MR. P. SPENCER.

MR. T. J. BENNETT.

MR. A. PEARSE.

MR. S. CATTLE.

The following Members were elected to the Council, viz. :—

MAJOR-GENERAL SIR C. WARREN.

PROF. G. F. FITZGERALD.

B. BADEN-POWELL, CAPT.,
Hon. Sec.

Langley's Aerodrome.

Even after making due allowance for the fervid utterances of an inventor flushed with success, the statement made in his annual report to the Smithsonian Institute at Washington, by such a scientist as Professor Langley is somewhat startling. He announces that he has reached a measure of success with his experiments which seems to justify him in making the statement "that mechanical flight has now been attained." There will, of course, be many who will make light of such an announcement, and look upon it as being, to say the least, premature. But, on the other hand, supposing the accounts we have received of the experiments, such as we published in our last number, to be correct, there can be little room for doubt but that a very successful *model* has been made. A horizontal flight of 1500 yards by a machine carrying its own motor is indeed a big step. It is true that that which may succeed as a model will not necessarily succeed when constructed of a larger size, but it must be remembered that this particular model is not like the flimsy little toys we have so often seen. A spread of wing of 14 ft., a steam engine capable of exerting more than one-horse power, a total weight of some 30 lbs., tells of something more than the model as hitherto understood by aviators. Then again, in considering the practicability of constructing a large apparatus, we have the recent experiments of Mr. Maxim, which go to show that the building of a huge machine with very powerful engines presents no insurmountable difficulty. However, most of us have already become convinced that a flying machine has theoretically and scientifically been proved a possibility. It is the practical details of construction and the efficient management that we have yet to learn. If Professor Langley now starts to put together a larger machine, there is every probability that within a year or two we shall be very near our desired goal.

Mr. Pilcher on Flying Machines.

On January 21st a lecture was delivered in Dublin, before the Military Society of Ireland, by Mr. P. S. Pilcher, on "Experiments in Flying Machines." General Viscount Frankfort de Montmorency, commanding the troops in Dublin, presided. The lecture was illustrated by numerous limelight views.

Mr. Pilcher began by pointing out that the history of experiments with flying machines has been up to the present more or less a history of disasters. After referring to the abortive attempts of Roger Bacon, of J. B. Dante, and of Le Bris, who, it may be remembered, was one of the first to use a simple soaring machine, the lecturer described in detail the experiments of Lilienthal. This experimenter

tried his first machine in 1891. It had about 100 sq. ft. of surface. In 1895 Mr. Pilcher saw him experiment with a machine of 150 sq. ft., which was roughly made almost entirely of peeled willow sticks, covered with cotton shirting. In the illustration shown, the man is holding the machine in the position it would be when flying, with his forearms passed through padded tubes, and his hands holding a cross-bar. This is the only way in which he is attached to the machine, so that he can, when standing on the ground, place the machine at any angle to the wind, and when supported by the air he can move his body a considerable distance forwards or backwards or sideways so as to preserve his balance and guide the machine. Professor Fitzgerald has one of these machines in Dublin.

To fold up, the front of the sail is unhooked from the front of the machine; all the spokes in the sail revolve round, and thus the machine shuts up quite small.

At first Lilienthal used to experiment by jumping off a spring board, with a good run. Then he took to practising on some hills close to Berlin. In the summer of 1892 he built a flat-roofed hut on the summit of a hill, from the top of which he used to jump, trying, of course, to soar as far as possible before landing.

One of the great dangers with a soaring machine is losing forward speed, and slipping backwards; or, having lost forward speed, inclining the machine too much down in front, and coming down head first. Lilienthal was the first to introduce the system of handling a machine in the air merely by moving his weight about in the machine; he always rested only on his elbows or on his elbows and shoulders.

This method of support, although it appears uncomfortable, is not really so bad as it seems, and one can soon get accustomed to it. It allows great freedom in moving one's weight about, and gives one an excellent command of the machine when standing on the ground. It has often been suggested that it would be a good plan to have a pair of stirrups to fit one's feet into while in flight, to have a net to sit in, or some such device to relieve the weight on the arms; but so far the length of flight has never been so long as to make such a thing necessary, and anything of this kind would be an encumbrance, and would hinder free movement, fidget one, and keep one from slipping out of the machine quickly in case of accident.

When Lilienthal made a good flight he used to land 300 ft. from the centre of the artificial hill, 50 ft. high (which he had had made in 1892), having come down at an angle of 1 in 6; but his best flights have been at an angle of about 1 in 10.

If it is calm, one must run a few steps down the hill, holding the machine as far back on oneself as possible, when the air will gradually support one, and one slides off the hill into the air. If there is any wind one should face it at starting; to try and start with a side wind is most unpleasant. It is possible after a great deal of practice to turn in the air, and fairly quickly. This is accomplished by throwing one's weight to one side, and thus lowering the machine on that side towards which one wants to turn. Birds do this same thing—crows and gulls show it very clearly. Last year Lilienthal chiefly experimented with double surface machines. These were very much like the old machines with awnings spread above them.

The object of making these double surface machines was to get more surface without increasing the length and width of the machine. This, of course, it does; but I personally strongly object to any machine in which the wing surface is high above the weight. I consider that it makes the machine very difficult to handle in bad weather, as a puff of wind striking the surface, high above one, has a great tendency to heel the machine over. The machine shown in this slide had about 250 square feet of surface.

Herr Lilienthal kindly allowed me to sail down his hill in one of these double surface machines last June. With the great facility afforded by his conical hill the machine was handy enough; but I am afraid I should not be able to manage one at all in the squally districts I have had to practise in over here.

Herr Lilienthal came to grief through deserting his old method of balancing. In order to control his tipping movements more rapidly he attached a line from his horizontal rudder to his head, so that when he moved his head forward it would lift the rudder and tip the machine up in front, and vice versa. He was practising this on some natural hills outside Berlin, and he apparently got muddled with the two motions, and in trying to regain forward speed after he had, through a lull in the wind, come to rest in the air, let the machine get too far down in front, and came down head first, and was killed.

The object of experimenting with soaring machines is to enable one to have practice in starting and alighting and controlling a machine in the air. They cannot possibly float horizontally in the air for any length of time, but to keep going must necessarily lose in elevation. They are excellent schooling machines, and that is all they are meant to be. When power, in the shape of an engine working a screw propeller, or an engine working wings to drive the machine forward, is added, then a person who is used to sailing down a hill with a simple soaring machine will be able to fly with comparative safety. One can best compare them to bicycles having no cranks, but on which one could learn to balance by coming down an incline. It should be much easier to keep a true balance in the air, when a motive power has been added, for in soaring it is less difficult to balance with a wind than without one, and in watching birds one can see how much less they have to balance themselves when they are flapping their wings than when they are soaring with their wings outspread and still.

Illustration 5 shows a machine which Lilienthal made in the summer of 1895, in which more than simple soaring is attempted. The extremities of the wings are made to flap, and constructed so that flapping would drive the machine ahead. The power was derived from a cylinder of compressed carbonic acid gas, and when Lilienthal pressed a valve with the thumb of his right hand, a piston in a working cylinder made a stroke, and caused the wings to give one flap. With this type of engine he was only able to carry enough power to last for about half a minute. He had several minor accidents with the mechanism of the machine, which delayed him, so that he made no real horizontal flights with it.

Mr. Pilcher then referred to his own experiments, of which he said: "I began to make my first soaring machine at the beginning of 1895. I had seen photographs of Lilienthal's apparatus, but I purposely made mine before going over to Berlin to see his, so as to get the greatest advantage from any original ideas I might have out. I was not able to make my first trials with this machine till June, 1895, after I had seen Lilienthal fly."

After describing his first machine, which had only a vertical rudder, he spoke of his next development. In this "there is a horizontal rudder as well as a large vertical rudder. Without the horizontal rudder I was able to do nothing—it was not until I had put on the horizontal rudder that I was able to leave the ground at all. Lilienthal told me that a horizontal rudder was absolutely necessary. I would not believe him, but found out that he was quite correct." In this machine the wings were very much turned up at the points, with the idea of facilitating the transverse balance.

"The upturned wings were all very well if there was no wind, or if the wind was steady; but if the wind shifted slightly sideways, and came on to one side of the machine, it would tend to raise the windward wing and depress the lee one, and capsize me sideways, which always meant a break. To obviate this, I built a second machine quite flat transversely, with the whole surface considerably raised so as to keep the wing tips a good distance off the ground."

Mr. Pilcher's machines vary from 150 to 300 sq. ft. surface, and weigh 50 to 80 lbs. The greatest distance he has covered is 100 yards.

"The great thing to be learnt with these machines is to land properly. One must before landing get right back in the machine, so as to tip it right up in front, and so bring the machine to rest in the air instead of on the ground.

"You will note that the horizontal rudder is made so that it can be lifted, but cannot be depressed. This seems to allow it to answer the purpose which is required of it, and saves it from getting broken if one tips the machine up a great deal, as is frequently necessary when coming to the ground.

"It is my intention this winter to make another machine very similar to this, but having a small oil engine situated just in front of me on the machine, with a shaft passing over my head, working a screw propeller of about four feet diameter, situated behind me. The machine will be started in exactly the same way as the soaring machines, by running down an incline, and when in the air the screw will be started to revolve, and in this way I hope to be able to maintain horizontal flight. From soaring machine experiments, it appears that an expenditure of energy of about two H.P. per minute is necessary. I shall therefore use an engine of about four H.P., because of the inefficiency of the screw and other losses. The flying speed would be about 30 miles per hour."

The third portion of the lecture dealt with Mr. Maxim's experiments. It was said that this great engineer happened to see some very thin and extremely strong steel tubing in France. Considering over the purposes to which such would be specially applicable, he thought of a flying machine, and thereupon started to construct one. The whirling table and other experimental apparatus having been described, the lecturer showed pictures of Maxim's great machine, and of details of the engines, boiler, and other parts. The aeroplane, it may be remembered, with a length of 104 ft. and a width of 125, presented an area of about 6,000 sq. ft., and the two engines were capable of exerting 360 horse power. Mr. Pilcher, after having described Mr. Maxim's last experiments, ended the lecture by saying: "Since this Mr. Maxim has done very little. I am now working with him, and I believe that we are shortly going to begin a new machine of quite a new type, about which I am not at liberty to speak."

The Chairman then invited discussion.

Capt. Baden-Powell, Scots Guards, said that among the audience there might be many who were not well versed in the subject, and who might not be able to comprehend exactly the object to be gained by these experiments with soaring machines. He might explain, for their benefit, that it was of the greatest value to those who intended ultimately to navigate the air to gain some acquaintance with the practical management of a flying machine in mid-air, to understand the effect of balance, and the results of the varying gusts of wind which an aerial navigator was likely to encounter. Much could be learnt in this way even while soaring down a hill-side. He had hoped to have heard something more from the lecturer with regard to Mr. Maxim's future intentions, but he had kept that very dark. There was no doubt we were getting nearer and nearer to the solution of the problem of flight, and when it did come it would be of the greatest importance from a military point of view, as it would then be possible not only to observe the enemy, but also to attack fortifications from above.

The Chairman said that, while he had not studied the subject very much, he was rather surprised to hear that flying machines had claimed so much attention so many centuries

ago. No doubt within the last ten years considerable progress had been made. But a few years ago to take such a problem in hand would have been considered the folly of a "crank" or person hardly sound. However, scientific men are now taking up the problem, and, so far as he could understand it, it seemed to be demonstrated that not only would we be able to fly, or rather that some machine would be invented to enable us to fly in the air, but that from a military point of view, the invention would be useful. For instance, a town might be bombarded from such machines, and it was possible that if the enemy had such machines they would try to get at the occupants of the others also. A few years ago, when cycles were proposed for use in the Army, the idea was rather scoffed at, but every army now used cycles, and probably before many years we would find flying machines coming into use in the same way.

Mr. Pilcher, having been voted the thanks of the meeting, suitably replied.

Soaring Flight.

The failure of the Henson machine (London, 1843) has been so repeatedly attributed to lack of power that it has become a commonly accepted idea that if this want be supplied, the thing is virtually accomplished and flight assured. In consequence of this belief, we see a number of machines posing as solutions of the problem of aerial navigation, all built on substantially the same plan, and being merely modifications of the Henson machine, including and retaining its defects and faults in construction. Horizontal and perpendicular rudders incapable of controlling the craft and propelling wheels so located as to continually disturb or destroy longitudinal equilibrium, may be relied upon to produce like results, however efficient the engine may be.

The Henson scheme is "to propel the aeroplane at a sustaining speed by the continuous thrust of screws." It is totally lacking in the essential element which characterises soaring flight as accomplished by birds.

The kind of flight attempted by these machines really bears more resemblance to flapping than to soaring flight.

In flapping flight birds are propelled by continuous thrust. The inclined position of the flapping wing in both ascending and descending movement furnishes a horizontal component of backward thrust, which is the equivalent of and mechanically the same as the action of a one-bladed screw (propeller) having similar pitch.

In true soaring flight birds are propelled by utilizing the motor powers of the aeroplane, and by virtue of the same construction and manoeuvres they may avail themselves of the extraneous aid of favouring winds.

The scheme for which I contend is, to so construct the machine as to enable it to fly in the same manner and be sustained and propelled by the same natural forces employed and utilized by soaring birds. Soaring flight is accomplished by birds with only a small portion of the power required to maintain flapping flight, and there is the same difference between my scheme and the Henson scheme in economy of power.

All soaring birds possess the ability to fly by flapping; they also know an easier way. Their ability to soar comes largely from size and weight. These are attributes which the flying machine will possess in greater degree, apparently giving it an advantage over the birds, and the same construction which serves to endow the machine with these powers also assists it to rise from the level ground, and enables it to alight without shock or jar.

The California machine recently advertised is said to be under perfect control: "it has a tail like a bird."

All of the machines recently exploited have similar appendages, but they are lacking in one attribute which a bird's tail possesses in an eminent degree.

A bird's tail is capable of striking vigorous blows upon the air. Birds do not make a succession of strokes with the tail, for the reason that one stroke is usually sufficient to correct their poise.

When a bird is moving forward the extended tail has the function of a horizontal rudder, with efficiency in proportion to speed of flight, and in case of soaring birds when under way this may greatly assist to control their position. But when rising from the ground or lighting, the rudder function is inoperative, and they make strokes with the tail just as smaller flapping birds may be observed to do.

There is another point which may be considered in this connection, wherein birds differ from the regulation flying machine.

The wings of birds have considerable latitude of motion fore and aft, and by simply moving them forward or backward a change in the longitudinal centre of gravity is made, and this is the way that birds in the act of soaring or sailing guide themselves on ascending or descending planes, and with all the grades at their command travel up hill or down as suits their whim.

The flying machine that has no equivalent devices must depend solely upon the horizontal rudder function of the tail, which is a lame dependence, and not so much like a bird as is supposed.

The regulation flying machine is also usually provided with a perpendicular rudder or tail, which is expected to control the direction of flight laterally or turn the craft right or left. This is not like anything found in nature among aerial creatures, and, being thoroughly inefficient, no argument is needed to condemn it. The swinging from side to side of a perpendicular rudder large enough to be effective changes the transverse centre of gravity of the craft, and tilts the machine sidewise.

Herr Lilienthal advocated and adopted curved surfaces because they give more lift

from a given area. This construction belongs to flapping wings, and may be serviceable in kites, but is of doubtful utility in soaring machines. Whenever a machine supported by one set of aerocurves or curved wings moves at a supporting speed, the tendency of the craft to follow the line of curvature of the supporting surface asserts itself noticeably, and with a moderate increase of speed the tendency becomes practically uncontrollable, and a wreck is imminent.

If curved wings are used there should be two sets of them, placed some distance apart, as shown in my machine. Then the path of the craft being the resultant of two sets of curves is approximately straight.

Curves, whether intentional or accidental, are a disturbing element in the soaring machine. It is true that the wings of birds are curved, but the birds are also provided with skill, strength, and appliances to manage them.

It may not be amiss to remember that the curvature of the wings of birds serves other purposes beside the requirements of flight. Birds are not always on the wing, and when walking or roosting the curvature serves an obvious purpose to enable the folded wing to fit the body and protect it from cold and wet. It also helps to give that comeliness of figure which nature chooses to bestow.

EDWARD OAKES.

Compressed Air Motors.

In a paper* read before the Liverpool Branch of the Horseless Traffic Association, Mr. Rhys Jenkins, M.I.Mech.E., discusses the application of "Compressed Air as a Motive Power for Road Vehicles." He bases his conclusions as to the production and expenditure of compressed air to a large extent upon the results actually obtained in practice in reference to tramway work, and upon the work done by the large air compressing plant designed by Professor Riedler for the Paris Compressed Air Supply.

While the pressures used in ordinary steam practice are also those best suited for compressed air motors, the necessity of storing an adequate supply of air within a reasonable space compels the adoption of very much higher pressures in the reservoirs. Pressures as high as 2,000 pounds per square inch are now in use for tramway work, but in the paper 1,000 pounds is taken as the standard pressure.

With a coal consumption of 2 pounds per indicated horse power per hour, it is estimated that air at this pressure may be produced at the rate of 5 pounds per pound of coal.

Great stress is laid upon the advantage of dividing the compressing process into two or more stages, with intermediate cooling.

The weight of the reservoirs for a given weight of air stored or for a given volume of free air is a very important consideration, but it is practically independent of the pressure. With a working stress of 10 tons per square inch, it amounts, including connections, to 10 pounds per pound of air. In the case of a vehicle, it is stated that the weight of the reservoirs, engine, gearing, &c., for a run of 10 miles would amount to one-third of the gross weight.

As the store of air is used up the pressure in the reservoirs falls, until it reaches a limit below which it cannot be usefully employed. The air then remaining is dead, and having regard to the fact that the vehicle has to carry not merely the air itself, but the reservoirs as well, the weight of which is far more serious, it is desirable that the motor should be arranged to work at as low a pressure as possible, so as to reduce the amount of the dead air.

The most economical way of working would be to admit the air directly from the reservoirs to the motor cylinders, but this means a very great range in the initial working pressure, which entails undesirable complications, such as multi-cylinder compound engines, variable expansion gear, &c., so that it was best to relinquish the advantages of high initial pressures, and to pass the air through a reducing valve, whereby a constant working pressure of, say, 180 pounds is maintained. The air may, however, be worked below this pressure by a variation in the ratio of expansion, down to, say, 90 pounds.

The importance of heating the air before using it in the motor cylinders is pointed out. By heating to a temperature of 320 deg. Fah., which may be effected at a trifling cost in a small coke stove, or by a petroleum burner, the volume of the air is increased by one half, and the consumption reduced in the same proportion; while by making use of a compound engine and reheating the air between the cylinders, the consumption is reduced by one-half. The consumption of air used in this way is 24 pounds per indicated horse power per hour. By saturating the air with steam, as in the Mekarski system, even better results would be obtained.

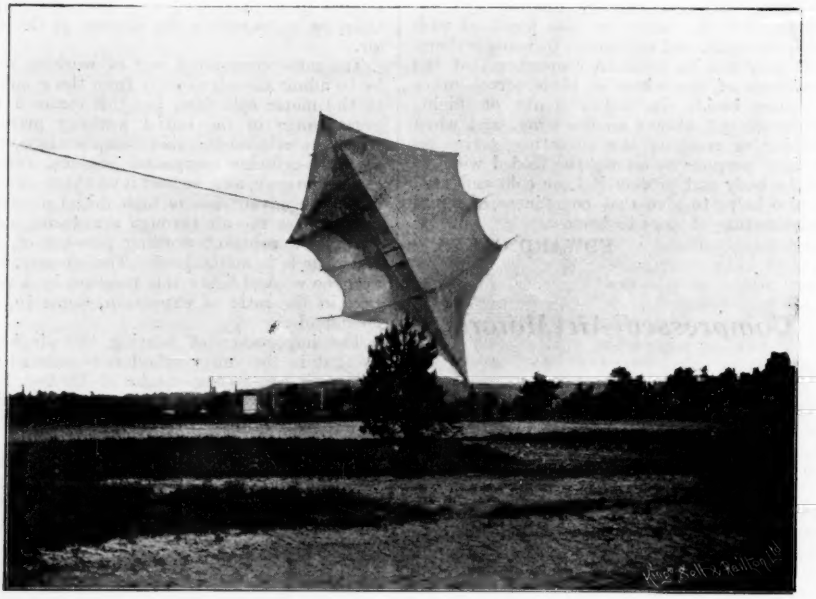
* Reported in full in *The Automotor*, 17th March, 1897,

Man-Lifting War Kites.

Recent experiments in America are attracting attention again to the subject of man-lifting kites, and it may be of interest to briefly recapitulate what has so far been accomplished in this line.

Passing by the achievements of Pocock, early in the century, of which no details are procurable, and the futile attempts of Mr. Simmons in England and M. Maillot in France, the first well-authenticated occasion on which a man was raised by a kite was on June 27th, 1894, when Capt. Baden-Powell, Scots Guards, conducted some experiments at Pirbright Camp

with a huge kite 36 ft. high. This consisted of a large hexagonal sheet of cambric, stretched on a framework of bamboo, presenting an area of about 500 sq. ft., and was flown on two lines, from which a basket was suspended. By this means men were repeatedly carried up to a height of about 10 ft. or so, the apparatus not being considered sufficiently reliable to risk attempting a higher ascent. Indeed, in the second photograph which we reproduce, and which gives a good idea of the size of the kite, it may be seen that an accident has happened, one corner of the kite having broken away from the framework. It is, of course, an extremely difficult matter to build such an apparatus without any sort of previous experience as to the strength required for the various parts. These



experiments were continued almost daily for some weeks, men being successfully lifted on many occasions.

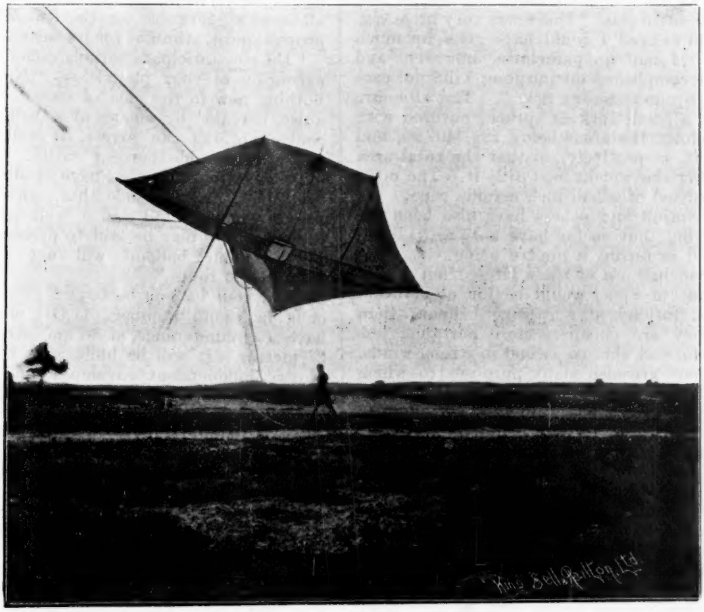
Capt. Pilcher about this time made some trials with a number of canvas discs attached to the string of a small kite, and by this means was more than once lifted off his legs.

On November 12th, 1894, Mr. L. Hargrave, in Australia, sent up four of his large "cellular" kites, with a result he thus describes:—"In about a quarter of an hour the wind freshened and raised me, when I found the velocity of the wind to be 18.6 miles per hour. The wind fell lighter, and I came down. Several more ascents were made, but not of sufficient duration to read the anemometer. However, a long and strong puff eventually came, and sent me up like a shot. A careful reading showed the wind velocity to be 21 miles per hour, with 240 lbs. pull on the spring balance. The weight aloft was:—The four kites, 30 lbs.; line, toggles, etc., 7 lbs.; man, 168 lbs.; total 208 lbs., raised by the 232 sq. ft. of lifting surface. . . Although the altitude was nothing to speak of, the conditions would be identical if the kites had been held by a mile of piano wire instead of the clothes line."

In April and May, 1895, Capt. Baden-Powell again tried experiments with some big kites at Pirbright, and on several occasions a man was lifted, and sandbags amounting to 6 stone weight carried to a height of about 200 ft. On one occasion, when there was practically no wind, 12 men ran along towing the kite, which was thus made to lift a man, and a few days afterwards the line was made fast to a cart and horse.

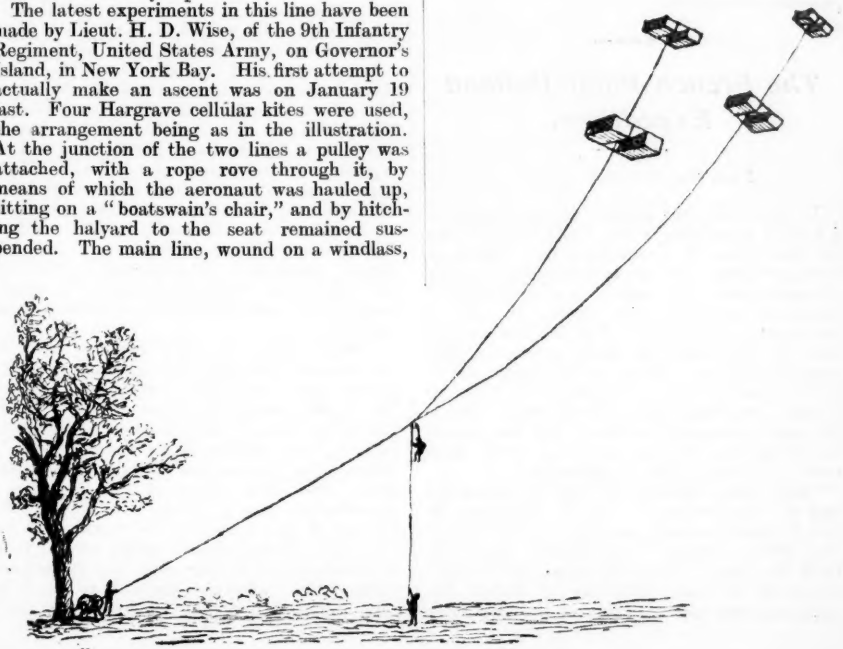
Finding many difficulties in the practical working of these big kites, Capt. Baden-Powell took to an arrangement consisting of a varying number of smaller kites, of about 110 sq. ft. area, and with them quite a series of experiments were made in the autumn of 1895. On eleven different days a man was lifted, four to seven kites being used according to the strength of the wind. On one occasion a weight of 9 stone was kept floating at a height of 300 ft. for the greater part of the day.

In September Capt. Baden-Powell exhibited his apparatus before the British Association at Ipswich, on which occasion, he, and others in turn, were lifted to a height of 100 ft., this being the length of the perpendicular rope by which the car was hauled down. A parachute



extended on a framework of bamboo was suspended above the car as a precaution against accident. The apparatus was then taken to Aldershot to undergo official trials, the results of which are not yet published.

The latest experiments in this line have been made by Lieut. H. D. Wise, of the 9th Infantry Regiment, United States Army, on Governor's Island, in New York Bay. His first attempt to actually make an ascent was on January 19 last. Four Hargrave cellular kites were used, the arrangement being as in the illustration. At the junction of the two lines a pulley was attached, with a rope rove through it, by means of which the aeronaut was hauled up, sitting on a "boatswain's chair," and by hitching the halyard to the seat remained suspended. The main line, wound on a windlass, was then run out, until Lieut. Wise had attained a height of 42 ft., where he remained for some five minutes. He says, "I was



amazed to see how little effect the weight had upon the main line. There was very little sag. Had I so desired I could have gone up much higher. I had no parachute, however, and having accomplished my purpose, I did not care to run any unnecessary risks." The kites are made of a framework of spruce, covered with cotton cloth, the areas being 22½, 40, 90, and 160 sq. ft. respectively, so that the total area supporting the weight was 312½ ft. The main line consisted of a half-inch manilla rope.

Mr. Lamson and others have also been experimenting, but so far have not, we believe, succeeded in raising a human being.

The principal use of these kites, from a military point of view, would be for observation purposes, instead of a captive balloon, than which they are cheaper, more portable, less vulnerable, and able to ascend in strong winds.

But there are also many purposes to which such an apparatus could be applied. To explorers, as in Arctic regions, they would afford a means of surveying the neighbourhood and obtaining a distant view. Steeplejacks and mountaineers would find them useful for attaining otherwise inaccessible places. The showman might find them an attractive amusement to those who would venture on the trip aloft, especially during race meetings and such-like assemblages. As a means of rescue from wrecks, or for getting to or from lighthouses or ships, for crossing rivers, and for very many more purposes they might prove of the greatest use. But such apparatus is also most interesting as a stepping-stone in aerial navigation. A kite which, during a calm, will lift a man while being towed along, is not far removed from the propelled aeroplane.

The French Polar Balloon Expedition.

From the *Pall Mall Gazette*.

To ascertain what is exact in the rumour of a French expedition to the North Pole, having for chief pilot M. Louis Godard, I called on that gentleman, who at once supplied me with all particulars. M. Godard is a distinguished aerostatic engineer, who builds, as well as commands, aerial ships. For the last twenty years he has been practically connected with aerial navigation. He is on the shady side of thirty years of age; is about 5 ft. 8 in. in stature, and weighs some eleven stone. He is of quiet, unassuming manners, but the possessor of an iron will and nerves of steel. In a word, a "daring pilot in extremity."

"And what, Monsieur le Chef, is the situation of your project?"—"It is supported by four Parisian journals, namely:—"Le Figaro," "Le Petit Journal," "Le Matin," and "Le Petit Parisien." The Committee has for president M. Rambaud, Minister of Public Instruction, and five members of the Académie des Sciences, including Mr. Faye, whose name alone is a guarantee for the feasibility of the project and a stimulus for its success."

"Do you anticipate serious difficulties in the execution of your plans?" — "No; there is nothing new in the idea of crossing the 'banquise boréale' by means of a balloon, whose course nothing can arrest, if well managed, and a favourable current exists. Since 1893 my associates and myself have studied the present plan, and conclude that, with a balloon suitably constructed and a well-chosen crew, the enterprise may be said to present no risks. Further, our balloon will not follow any marked-out route."

"Will your balloon be large?"—"It will *per se* cube in round numbers 11,000 metres; will have a circumference of 86 and a diameter of 27 metres. It will be built with silk, consist of two independent envelopes, one sheathing inside the other, but both uniting at base and summit by valves, furnished with similar valves at the circumference, and arranged according to a special system. It will also have an air balloon of a small but determined capacity, attached, to aid in maintaining the geometric form of the balloon, to assist in working any scheme of deviation, and in contributing to the floating in cold regions. The netting, its hooping, and peculiar cordages, will weigh 1,525 kilos; the steadying guide-rope, cable, anchor, &c., 520 kilos. The car will weigh 625 kilos, and be rectangular in shape, of a capacity of 2 by 2½ by 2 metres, and covered overhead; on its roof, or deck, the working operations will take place. The interior of the car will consist of cabins in which to repose, eat, record observations, one being reserved for a laboratory. The weight of the balloon proper with these fittings will be 4,550 kilos."

"And your crew?"—"It will comprise seven persons, representing a total weight of 560 kilos, or an average of 12½ stone per individual. The provisions are calculated for 120 days, at the rate of 3¼ lb. daily per person, and will represent a total weight of 1,200 kilos. Photographic apparatus, scientific instruments, folding boats, sledges, arms, duplicate ropes, anchor, ballast, &c., will make a total weight of 7,450 kilos, which, added to the 4,550 kilos already mentioned, will represent a grand total of 12,000 kilos. The ballast alone will weigh 3 tons 12 cwt., and will consist of small shot and water."

"What about the inflation?"—"That will be effected with pure hydrogen gas, sufficient to tide over a voyage of forty days; but with the twelve gasometer balloons, suspended between the car and the equatorial section of the balloon, each cubing 250 metres additional hydrogen, the journey can be extended to sixty days. One cubic metre of pure hydrogen is estimated to raise a weight of 2 lb. 6 oz. The leakage of gas, based on the working of captive and military balloons during several years, is calculated at 1½ per cent. per twenty-four hours. Even allowing the loss to be 2 per cent. sufficient hydrogen would remain for a

voyage, that is to say, to float in the air, during fifty days."

"How long do you expect your exploration journey to last?"—"With a favourable wind, moving at the rate of four metres per second—the mean velocity of the wind at Spitzbergen, based on 1,000 observations taken during fine weather, and when there is no night—or fifteen kilometres per hour, the balloon would travel daily 360 kilometres, or 225 miles—that is to say, 13,500 miles, during sixty days. But the contemplated voyage of exploration is not expected to exceed twelve or fifteen days, equivalent to a total journey of 3,375 miles. Now, the distance of unexplored territory between Spitzbergen and Behring's Straits is about 2,000 miles, so that a liberal margin has been allowed for the run."

"How do you propose to prepare the hydrogen gas?"—"The Minister of Marine will be asked to place a steamer, with a crew of 30 hands, at the disposal of the Committee, to transport the cargo, some 300 tons, to Spitzbergen. To produce the requisite amount of gas—18,000 cubic metres—including accessories, &c., 179 tons of sulphuric acid, and 72 of iron, will be needed. Pending the inflation no shelter will be required for the balloon; it can be safely anchored to the ground, a 'captif,' and fully able to resist a gale blowing at the rate of seventy-eight miles an hour."

"What about your crew of seven brave men, commencing by your worthy self?"—"My first assistant, who is my colleague and associate engineer, will be M. Surcouf, who is well known as an experienced aeronaut; there will be two sub-assistants, one meteorological chemist, one Arctic navigator, to be nominated by the Geographical Society, and a navy surgeon to be selected by the Admiralty."

"What will be the cost of the expedition in question?"—"Ten thousand pounds sterling, to be obtained from promised donations, public grants, and a national subscription. Conferences are on the eve of being organized all over the country, to enable France to have the honour of solving the mystery or the enigma of the North Pole."

"But, Monsieur le Chef, what respecting the peril, the unknown?"—"No danger daunts us, nor do we value or estimate the difficulties as excessive, secured as we will be by every scientific and mechanical appliance." M. Godard is of the same mind as the Knight of Snowdon:

"If the path be dangerous known,
The danger's self is lure alone."

The balloon duly inflated at Spitzbergen, the "let go" will be pronounced on the first favouring breeze. If the expedition cannot attain the Behring's Straits, but be blown back, the travellers will bow to the inevitable; but they are resolved to remain "up" fifty to sixty days, so as to realize that fact alone, which will be no insignificant "lever de rideau" for the grand piece certain to succeed later.

Before leaving my learned friend I asked him his opinion about the Andrée Polar Expedition. M. Godard merely observed he did not approve of the principle of the construction of its balloon, though made, all the same, in M. Godard's own factory.

*On the Cellular Kite.**

By Lawrence Hargrave.

As there is little doubt that the cellular is a permanent type of kite, a few remarks will be of interest, especially as its action and construction as hitherto explained are somewhat obscure. The first question that suggests itself is, why should the cellular lift more per square foot than the ordinary single surfaced kite? In a kite or flying machine the distribution of the lifting surface is most important. The value of the lifting surface depends within certain limits on the linear dimension that first meets the wind. Thus, a common kite of 25 square feet area cannot show more than about 7 ft. of edge to the wind, whereas a cellular one of 25 square feet area can easily show 20 ft. of edge to the wind.

The great stability of the cellular kite is due to the vertical surfaces. To understand this, it is necessary to grasp the truth, that a perfectly flat kite has no stability; and even with tail and side ropes is an inferior flyer. The more the kite bends back from the longitudinal centre line or backbone, the more stable it becomes. The angle between the two sides is called by flying-machine men the diedral angle, and without this or its equivalent, no flying apparatus will balance with any degree of certainty.

Let A B C be the diedral angle of a kite, B being the end view of the backbone. Resolve A B and B C into their components, and D B E

is the breadth of surface that tends to life the kite, and A D and C E are the heights of the surfaces that tend to steady it. Bisect D B and B E, and erect perpendiculars F H and G K equal to A D or C E, join H K, and F H K G is the breadth and height of a cell having the same lifting power as A B C and (apparently) greater stability.

The width of the kite D E is halved, and therefore much less timbering spreads an equal area of lifting surface, to say nothing of the rigidity of the lattice girder construction.

To realise this question of stability from another point of view, let us imagine a flying machine with its lifting surfaces in the diedral fashion A B C, and one with two cells like F H K G, to be on their respective stages, rails, carriages or floats, ready to fly; suppose them to have equal areas, weights and wheel or other bases and to be heading directly to the wind; a momentary change of wind would promptly overturn A B C, but F H K G would only be pushed sideways. Suppose both

* Paper read before the Royal Society of N.S. Wales, Aug. 5, 1896.

machines to be flying at the same speed and to require to turn to the right suddenly. They each port their helm, with the result that the diedral one turns on its beam ends to starboard, and the cellular one loses way, due to the amount of vertical surface, and develops a slight listing to starboard.

A comparison of the scale drawing of a 90 square ft. kite, with Plate 8 of the paper on "Aeronautical Work" read here on June 5th, 1895, will show detail improvements that have lately been made. The 1895 drawing shows the main frame to have had three king-posts and four diagonal wire ties; these are now abolished and the cells brought closer together longitudinally. The frame now consists of two pieces of wood, each three times the length of the cell, united by the ties (B) at the centres of each cell. The effect of this alteration is that the crossings by tape or string hinges to the continuous booms; this brings all compressions of the truss work of each cell into one plane. The outer ends of all the booms have wooden cleats (R) lashed on top and bottom, so that the jackyards (E) fitting exactly between them receive the thrust truly square. The inner ends of all the booms are quite square, and rest in beds on the main frame. There are no metal ferrules, joints, nails, or shoes on the kite. The sticks for bending the surfaces (F) have a versed sine of 1.125 in. They are not steamed, or held bent by a cord or wire. They are simply made in two or three layers of wood united with glue. The sticks retain the form given them, and acquire an extra stiffness due to the glue. The total weight of this 90 square feet kite is 12½ lb.; at least a pound of this might be saved by using light muslin instead of calico.

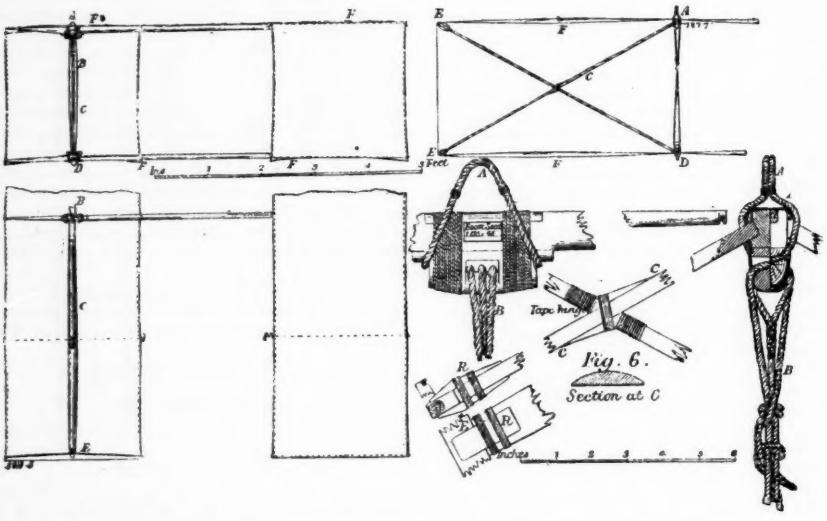


Fig. 6.

the kite is equally strong with less material, and it will fold to a close bundle 7 ft. 6 in. long, with a maximum circumference of 16 ins. This makes the question of transport a very simple matter.

The strop for the kite line (D) and that for any kites that may be flown above (A), pull on to the tie of the forward cell, so that no special rigging is required for tandem flying. The fabric of the surfaces can be adjusted easily to any degree of tension by the ties (B); previously it required some effort to fleet the boom shoes along the main frame. The booms (C) for pushing out the jackyards (E) are of plano-convex section instead of being round; this adds a little to their weight, but something is gained by the reduced head resistance, and the lift due to the plane underside of the booms. The booms for the lower corners are continuous; those for the upper corners are joined at

The lifting power at the ultimate strength of the structure is not known; it is estimated to be about 3 lb. per square foot, and that a wind of 30 miles per hour would not break it or make it dive. This kite was flown on July 22, at 2 p.m. You will remember the weather as reported in the "Sydney Morning Herald" next day. One of the jackyards broke at a small nail hole, and one pair of booms fell to the ground, but the kite continued to fly steadily. It is this remarkable stability that makes the cellular form of aeroplane so suitable for flying machines, and it is a matter of surprise to the writer that other experimenters do not adopt it, especially as there is no charge for its use.

For man-lifting purposes, small kites are better than large ones. For instance, a 19 square feet kite has been made that weighs 19 ounces, and folds to about the size of an umbrella; ten of these could be tucked under one's arm, and

with a coil of line and a decent breeze an ascent could be made from the bridge of a torpedo boat or the top of an omnibus.

Some confusion has arisen through the apparent ambiguity of the definitions of the dimensions of cellular kites. They fly at such a high angle, and present such a small projected area to the wind, that when viewed from below misunderstanding cannot ensue if:

Length equals the dimension in the direction the wind is blowing.

Breadth equals the dimension horizontally at right angles to the length.

Depth equals the dimension vertically at right angles to the length.

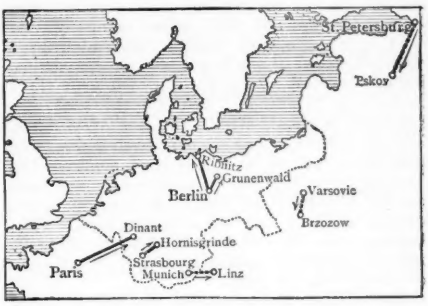
Exploration of the Atmosphere by Balloons.

An international committee, under the presidency of Dr. Hergesell, was formed some time ago with the object of conducting experiments in meteorology, with special reference to observations of the state of the atmosphere at a great elevation. With this object it was decided to send simultaneously from different places on the Continent a number of balloons carrying observers or self-registering instruments. The first experiment was made on November 14th last, when balloons were sent up from various towns. The following table and map give the principal particulars:

Balloon Ascents on 14th November, 1896.

	Capacity of Balloon. c. ft.	Start. Local Time a.m.	Greatest Altitude. ft.	Greatest Cold. °C.	Duration of Voyage. hrs.	Distance Travelled. miles.
Paris	13 055	2h. 6m.	49,500	— 60	4h. 23m.	136
Strasburg ..	12,250	2 0	26,400	— 30	1 20	18½
*Berlin	45,500	2 48	18,480	— 24·4	11 37	—
"	8,750	2 51	19,140	—	1 0	*burst.*
*St. Petersburg	35,000	4 45	15,048	— 22·8 (at 10,500 ft.)	6 45	136
"	—	4 0	4,950	— 13	0 15	—
*Warsaw ..	35,000	3 15	10,470	— 20	9 35	—
*Munich	45,000	6 32	11,050	— 6·5	7 10	124

* Carried men, the others instruments only.



(*From Cassell's Magazine.*)

A second series of ascents was made on February 18th, at about 10 a.m. Two balloons with observers and one with instruments only ascended from Berlin (in the presence of the Emperor). A balloon with recording instruments ascended from Paris, and descended after two hours, having run 63 miles in a N.N.E. direction, attaining an altitude of over 33,000 ft. Other balloons ascended from Strasburg and St. Petersburg.

Ascent of a Squadron of War Balloons in Russia.

The *Militär Wochenblatt* (Jan. 6.), quoting from the *Russische Invalide*, reports on the inspection of the officers attached for instruction to the School of Military Ballooning at St. Petersburg, after their school examination, in order to test their ability to direct free balloons. With this object, three balloons, "Nadajaschny," "Kobtschik," and "Ssmalui," ascended simultaneously, on the word of the commander of the school, at 12.30, on Oct. 14. Each contained 22,500 cubic ft., and was filled with coal gas. There were two officers in each car. The weather was favourable, the wind north, and the velocity of the clouds about 20 miles per hour. The carrying power of the balloons was nearly alike; each had four sacks of ballast. Orders were given to ascend to a height of at least 3,000 ft. On rising, one of the balloons fouled another, but got clear, and at a height of 600 ft. one of them passed so close under the car of another that the occupants of the latter had to shove off with their hands and throw out ballast so as to ascend. This critical situation lasted for about five minutes. Two of the squadron had used each three sacks of ballast on reaching a height of 3,000 ft. At a height of 4,500 to 5,000 ft. all took a southerly direction, and

kept so close together that conversation could be carried on from one to another. For forty minutes after reaching the greatest altitude no ballast was thrown out, and on the latter half of the journey they parted company. At 2.11 p.m., the first balloon descended in a wood-clearing 4½ miles east of Gatschina, having covered 30 miles, of which over three miles was "trailing." At 4.3 the next also landed in a wood, after a journey of 45 miles, but was for some time suspended in a tree, and had afterwards to be removed on sledges. The last of the squadron on descending was also caught in a tree, and had to be brought to the ground with the help of some peasants. The landing was effected at 4.8, after coverin 39 miles. All three landed in a line at intervals of about 6 to 10 miles.

The School of Ballooning has taken a prominent part in the exhibition at Nijny Novgorod, where, in a separate pavilion, were shown a great variety of apparatus and appliances mostly invented and made in the school; also photographs of incidents in aerial navigation, photographs taken from balloons, maps, plans and reports, as well as the programme of instruction and a quantity of balloon literature in the Russian language. It is impossible to enumerate all the inventions and improvements which have been made in this field by the staff of the Balloon Park for calculating the direction of the wind and the path of balloons at different heights, their construction, filling, and transport, optical apparatus, measures of security, etc. A Russian writer says:—"We must come to the conclusion that aerial navigation in Russia rests, considering present technical conditions, on a very solid and quite independent basis, in no way inferior to that in other armies. During the ten years' existence of the Balloon Detachment it has not had a single accident, and in this it differs from those of other countries. In many respects, particularly in the investigation of the atmosphere and the use of currents, the Russian Ballooning Service can claim the first position."

NOTES.

THE UPPER RHINE AERONAUTICAL SOCIETY.

We are glad to note that, according to the latest account sent us, this Society, which has only recently been started, seems to be progressing in a most satisfactory manner. The number of members is now over 200, a large proportion being military officers. At the last meeting it was unanimously decided to build a balloon for the Society, forty-two £1 shares being subscribed by 27 members. Experiments with kites were to be conducted every Saturday afternoon. The Secretary is Capt. Moedebeck, Kalbgasse 3, Strassburg.

THE COST OF WAR BALLOONING.

In the Army Estimates for 1897-8 a sum of £4,650 is set aside for the purposes of military ballooning, as against £3,150 last year. £600 is also to be spent on buildings for the Balloon Depôt.

In the Italian Army Estimates 600,000 francs (£24,000) is to be devoted to "Increase, Balloon, and Optical Material."

About £2,300 is said to be the German contribution for military ballooning purposes.

KITES FOR METEOROLOGICAL INVESTIGATIONS.

Mr. H. Helm Clayton, of Blue Hill Meteorological Observatory, writing about the use of kites for meteorological observations, says:—"The ease with which a meteorograph can be lifted to the height of a mile is shown by the fact that it was accomplished three times in four days during August in normal weather conditions. The highest point reached by no means represents the highest point attainable with kites, since at the time of the highest ascent the pull of the kites on the line was 100 lb., while the breaking strain of the line is over 300 lb., so that had there been more wire on the reel a much greater altitude might have been reached. Three, or possibly four or five, miles does not seem unattainable. The importance of such observations for the further development of meteorology is shown by the fact that the weather conditions at the height of a mile above any station differ more from the weather at that station than does the weather at any place within 500 or 1,000 miles at the level of the station on the earth's surface. At the height of a mile in the free air the temperature is usually from 15 degs. to 25 degs. Fahr. colder than at the earth's surface, and there is virtually no change in temperature, the nights being as warm as the days. The only changes are due to the passage of warm and cold waves. During fair weather at this height the days are very damp, and the nights extremely dry. Low clouds frequently cover the earth, and even rain may fall from these while the sun shines bright at the height of a mile. The average velocity of the wind at this height is four times greater than at the ground, and hurricanes of 100 miles an hour are not uncommon. At least, the meteorograph records obtained by kites, and measurements of the heights and movements of clouds with theodolites, indicate that these are the conditions which exist above Blue Hill."

The latest idea from America is to fly kites from the summit of Mount Rainier, the highest mountain in the United States. With a start of over 14,000 ft., it is expected that an enormous altitude will be attained. Still, we should have been inclined to think that, considering the expense and trouble of getting to

the summit of this great mountain, better results might be more easily obtained direct from the ground. Even if kites cannot be got up to so great a height, balloons certainly could get much higher.

GORDON'S SOARING MACHINE.

A new soaring machine, somewhat similar in general design to that of Lilienthal, has lately been tried by Mr. N. R. Gordon. The wind, however, was unfavourable on the first day of trial, so that no very satisfactory results were obtained. Mr. Gordon hopes, however, to make further experiments during the summer. The spread of wing of the machine is 37 ft. 6 ins., and the average width about 5 ft. It is strongly made with piano steel wire bracings to the wings, and weighs 70 lbs.

A GUNPOWDER MOTOR.

The "New York Herald" gives a description of a new engine actuated by the explosion of gunpowder. The engine described is for application to a bicycle, which it is said to be able to drive for 100 miles on end. As, however, no details are given of its actual performance, its practical success seems, at present, not to be fully proved. The engine weighs $8\frac{3}{4}$ lb. The cylinder, 3 ins. long and 1 in. in diameter. The exploding chamber is 2 ins. long, $1\frac{1}{2}$ ins. high, and $1\frac{3}{4}$ ins. wide. Above the cylinder is the powder magazine, 4 ins. diameter and 2 ins. deep. The explosion of the powder generates a "gaseous smoke," which acts much the same as steam in a steam engine. The gunpowder is conveyed from the magazine to the exploding chamber by means of an automatic feeder.

METEOROLOGICAL FORECASTS.

The report of the Meteorological Council to the Royal Society for the year ending March 31, 1896, has just been issued. The forecasts are prepared three times a day, at 11 a.m., 3.30 p.m., and 8.30 p.m. They are available for the information of anyone who applies for them at the office. As regards the correctness of the forecasts, 55 per cent. proved completely successful, 25 per cent. partially so; so that the total percentage of successes was 80. The average of success for the years 1886-95 was 81.5 per cent. The amount voted by Parliament for these services during the year was £15,300.

NEW PROJECTS FOR AERIAL NAVIGATION.

A beautiful picture of Davidson's "Air-Car as it will appear when completed," has been sent us, but, as the prospectus says, "this drawing does not show the detail," and until we know more of it, we shall be unable to feel any confidence as to its eventual success.

A glowing account, plentifully illustrated, is given in the "Philadelphia Engineer" of a machine invented by Mr. C. E. Hite, of Philadelphia. It appears, however, to be at present only a small model, which is driven along suspended from a wire. The idea seems to be nothing more novel than that of a sausage-shaped balloon, propelled by fans, to be driven by a 35 horse-power steam engine.

Another somewhat similar design by Mr. H. C. Robertson figures in a later number of the same journal.

Yet another wild idea is pictured and described in an American paper. Whether the original design is more practical we cannot say, but according to this account Mr. Skobeloff, a Russian "naval expert" at Vladivostock, has designed a machine consisting of three cylinders of aluminium, the largest of which is 18 ft. long and 8 ft. diameter, filled with gas. Below sits the man working the propeller, *a la* bicycle. It seems almost superfluous to point out that this volume of gas would not be capable of lifting more than about 70 lbs.

SOME NOVEL IDEAS ON ARTIFICIAL FLIGHT.

We have received several long letters from Mr. T. G. Challis, from which we extract a few of the most interesting items, many of which are really original. This gentleman is evidently an authority on the subject, to quote his *own words*. "I began on this Problem of aerial flight just 35 years ago this coming summer, and studied and worked allmost incessentionlly for 33 years that is I got over the last difficulty that of ballancing the machine in the air with safety on the morning of June the 4th, 1895 exactly 33 years after I began the first stroke i am very well aware that you will have some difficulty in believeing this statement I can hardly expect you to do so without some little proof of some kind or other—but still as far as you can take my unerforced word i can asure you that what i say is the truth absolutely the truth—you may take it that i should not take upon myself the terrible Responsibility of declareing before the World that i had solved the Problem of aerial flight if i had not realy done so." Later on he gives a truism often forgotten:—"before you can hope to do this you must make yourself well acquainted with the principles," and says, "you must keep studying the mechanical action of the natural flying machine the Bird till you fairly Recognise how the whole thing is done this is quite open to you have as many lessons as you like all is free dame nature unlike mecreny man gives splendid lessons free." He then states:—"I venture to say this invention will be full of supprises especialy to the scien-

tific world but the most suppriseing supprise of all will most undoubtedly be the supprise that anything so extremely simple was not seen long before." Speaking of artificial flight, he says:—"it is destined to come all things point to this end we can not stand still even if we wished it." But here comes a really novel reason for the desirability of a flying machine: "The air is destined to be the great highway of the worlds commerce in the future because the Land will be wanted for a more important purpose namely that of growing food for the teemenng millions that will by and bye inhabet the earth curious enugh just as Stephensons invention of the Railway and Locomotive engine Robed mankind of millions of acres of fertile Land so will the invention of the Fairy Carraige of the future the flying machine restore this Land back to its right purpose that of growing food." Then comes a point on which we certainly beg to differ with this unassuming authority: "It is very difficult for me or any one else to say but I should gess that the speed of the first practical and safe flying machine would be from two to four miles an hour it most certainly will not be very fast." We think it will; however, our correspondent is encouraging when he tells us, "I consider traveling in the air will be in time to come about the saftest mode of travel as well as the plesentest." We hope it will be so. Mr. Challis then takes us rather into his confidence when he describes the trial machine which he proposes to build: "It will be constructed in a very fancifull stile with the true design disguised as much as Possible for Reasons you will understand" (which, however, we don't) "as I have designed it it will be a spendid looking afair in fact it will be more to please the eye more than for any other purpose" (this we can quite believe) "this you will understand will be in Reatily the first practical flying machine ever constructed in the world's history." "Praps," he says, "you will be a little supprised when I tell you that I have not a single drawing or a moddell of any kind," but adds, "but this does not matter in the least." He ends up the long correspondence—which, by the way, we shall be happy to show to anyone interested in it—by saying: "A great industry will follow this (invention) that will be in time to come so vast and farreaching in its proportions that the Great Railway industry of the world gigantic as it is will pale before it as the morning star Pales before the radiant riseing sun."

Recent Publications.

Kite Experiments at the Weather Bureau (United States), by Prof. Marvin, is a reprint of articles which have appeared in the "Monthly Weather Review," beginning April, 1896.

In November, 1895, Prof. W. Moore, the chief of the Weather Bureau, directed the author to consider the subject of kites and auxiliary apparatus for the meteorological exploration of the upper air. The result is that Prof. Marvin has conducted a most interesting and useful investigation in scientific kite flying, and the book forms what is probably the first work devoted to the subject.

Dr. Andrew Wilson, of Glasgow, seems to have been one of the first to apply kites to meteorological purposes, and an account of his experiments in 1749 are recounted. Mr. Birt in 1847 flew a kite at Kew Observatory for obtaining measures of the temperature, humidity, etc., of the air. Mr. Douglas Archibald's experiments in 1883 are then referred to, and those of Mr. Eddy in the United States in 1890. After mentioning the experiments of Mr. A. L. Rotch, at Blue Hill, of Mr. Hargrave in Australia, and others, the author describes the first attempts at the Weather Bureau.

Professor Marvin insists on the importance of applying scientific principles in the construction of the apparatus, instancing the slow development of the steam engine, which became built up piece by piece, and took nearly 200 years to become an efficient machine. Electric generators, on the other hand, of which "all the principal elements of their theory had been fully developed before the devices were invented," attained the highest state of perfection within a few years.

There has always been an uncertainty with kite flyers as to whether it is best to employ one big kite, or several small ones in tandem. The writer points out that "the tension on the string varies greatly when only one kite is flying, owing to the tumultuous and ever-changing character of the wind. These variations are very much less with two in tandem 200 or 300 feet apart. With a tandem of several kites the strain is naturally still more nearly constant;" but later on he adds, "Yet the gain in steadiness when more than two or three kites are employed is entirely unimportant, and a large kite is more effective than an equal surface in small kites."

The first experiments were made with "Malay" kites. These are formed of a four-

sided piece of stuff or paper stretched on a framework consisting of two sticks of about equal length, crossing one another at a point, say, a quarter of the length from the top of the upright stick, the cross stick being bowed backwards. "The general conclusion, however, is that single-plane kites are believed to be less reliable than kites of the cellular type." The latter, though heavier in construction, being much steadier in strong winds.

As regards the theory of kite flying, Prof. Marvin points out that there are five independent forces to be considered. Not only have we to take into account (1) the pressure of the wind on the kite surface, (2) the attraction of gravity, and (3) the tension of the string, but also (4) the attraction of gravity for the string, and (5) the wind pressure on the string. The two last, though not of much importance when the strings are short, become very necessary of consideration when miles of line have to be lifted to the skies.

The analysis of the forces acting on the kite is carefully gone into, and diagrams given to show the direction and amount of the resultant pressure. The lift, increasing with the strength of the wind and the lightness of the kite, and the drift, consisting of the horizontal action of the wind, augmented by the skin friction and by the pressure on the front edges of the kite, combined, are opposed by the pull of the string.

We are inclined to think that Prof. Marvin takes, perhaps, rather too much account of gravity as a condition of importance to be considered. Though, of course, in a very light wind, its influence may be considerable, still, a kite weighing, say, 5 lbs., will usually show a pull on its line of some 50 lbs., and often as much as three times that amount. But then, on the other hand, most of the kites used by him seem to have been very heavy ones.

The position of the centre of pressure is gone into; also the effect of arched surfaces. Another important consideration is the lateral stability of the kite, and the effect of the bending back of the lateral wing surfaces so as to form a dihedral angle. The result of an increase in wind pressure is discussed, and the use of the usual form of bridle shown.

One of the greatest difficulties that a kite-flyer has to contend with is the variability of the wind force. The author points out that the force of the wind at 30 miles an hour is fully nine times as great as at 10 miles per hour.

The tests and methods of testing the lines and other portions of the apparatus are interesting. A table is given, showing the relative strengths and weights of various strings and wire. Steel piano wire is, of course, shown to be the most suitable; aluminium wire being, considering its small tensile strength, the worst. The method of joining steel wire presents a practical difficulty, but is best accomplished by twisting the ends together, "the wires being evenly and uniformly twisted each about a common axis," and not one twisted round the other. The joining of hempen cords is also carefully gone into. As is (or should be) well known, almost every knot forms a weak point in a string. But from a number of trials, Prof. Marvin found that a "bowline" was by far the strongest knot; indeed, the average of 10 tests shows the breaking strain to be greater with such knots than without! But this, of course, can only be accounted for either by the chance of having selected some stronger pieces for the knotted specimens, or that the method of holding the unknotted cord was not quite efficient. The writer makes no mention, however, of splices, which, though perhaps difficult to make, are probably more satisfactory than any knots.

Descriptions are given of the methods of eye-splicing the wires, of reeling in the lines, and measuring their lengths and tension.

Illustrations are given of some 15 different forms of cellular kites, and no less than 36 kinds are described. We can only state shortly that the effective sustaining surfaces of these varied from 6 to 45 sq. ft., the weight per sq. ft. being about .05 to .07 lb.

The strengths and weights of various materials for kite construction are carefully gone into.

The "catenary," or curve of the retaining line, is treated of from a mathematical point of view.

Altogether this little work forms a most com-

plete account of kite flying from a scientific and practical point of view, and it will form a text-book of the greatest value to the kite-flyer.

Foreign Periodicals.

L'Aérophile (Paris) for January-February commences with a short account, by M. W. de Fouvielle, of "M. Berthelot and his Connection with Scientific Aeronautics." Then follows the "Speech of M. Janssen," delivered at the banquet of the aeronauts of the Siege of Paris, which was held in December last. The speaker, it may be remembered, escaped from Paris in a balloon, in order to observe an eclipse of the sun in Algeria. A detailed illustrated description by M. Hermite of the balloon and instruments sent up from Paris in connection with the "International Ascents" for the exploration of the high regions (referred to elsewhere) is given, also short accounts of the other balloons sent up on that occasion. Proceedings of the "Commission Scientifique d'Aérostation." Viscompte Decazes continues his elaborate "Theory of the Dynamic Soaring." M. G. Garcia gives an account of an "Aerial Voyage by Stages."

L'Aéronaute (Paris). The January number has an article by M. Leopold Desmarest, on the "Last Experiment but One of Otto Lilienthal," chiefly consisting of a translation from the "Boston Transcript." The author of the article points out that during the time Lilienthal used an apparatus with a single plane he never came to grief, and that, though superposed planes give a greater surface with less spread, there is a greater difficulty in the balance when the centre of gravity is low. Moreover, in a machine subject to the variable gusts of wind, it is especially important to have a good control of the balance.

The issue for February contains an account extracted from the *Illustrirte Zeitung* of "Stentzel's Wing Machine" (of which we gave a short account in our last issue). The writer points out that this machine does not in reality resemble so much the apparatus of Lilienthal as the models made some years ago by M. de Villeneuve and by M. Pénaud. The machine is suspended from a horizontal wire, along which it travels propelled by the beats of the wings. Mr. Stentzel intends building a larger machine. The "Bill for the Encouragement of Aerial Navigation," brought before Congress in the United States in 1895, forms the subject of an article by Mr. James Means. Reports of the meetings of the Societé Française de Navigation Aérienne follow.

The March number commences with a translation of the "Funeral Oration on Otto Lilienthal," delivered by Dr. K. Mullenhoff in Berlin, the remainder of the journal being taken up with accounts of the proceedings of the Society, which include many interesting announcements, mostly culled from the periodicals.

Notable Articles.

(*Jan., Feb., March.*)

Engineering, Jan. 1.—Detailed Description of "Cellular Kite." By L. HARGRAVE (*vide page* 9).

Scientific American, Jan. 23.—Illustrated Description of "Dr. Wardwell's Folding Kite."

Nature, Jan. 22.—Letter from S. E. Peal on "Flight of Birds."

Engineer (Philadelphia).—"Mr. Hite's Device for a Navigable Balloon." Illustrated.

Nature, Feb. 25.—Letter from F. W. Headley on "Flight of Gulls."

Cassell's Family Magazine for March.—"With a Camera in the Clouds," by MAURICE FARMAN. An illustrated account of a balloon trip in France with M. Besançon, lasting nearly 18 hours, during which a number of photographs were taken.

Daily Graphic, March 23.—"Sounding the Atmosphere." Illustrated account of the international ascents.

In the *United Service Magazine* or April will appear an article on "The Conquest of the Air," by Capt. BADEN-POWELL.

In the *Strand Magazine* for June will appear an article on "Aerial Photography," by Mr. G. FITZGERALD.

Applications for Patents.

770. Jan. 11, 1897. R. M. BALSTON, 46, Lincoln's Inn Fields. **Improvements in Flying Machines.**

1273. Jan 18, 1897. JAMES MURRIE, 12, Houldsworth, Street, Glasgow. **Improvements in Aerial Navigable Vessels and Apparatus in connection therewith.**

2351. Jan. 29, 1897. J. D. WHITE, Fairfield, Redhill, Surrey. **Improvements in Flying Machines.**

3608. Feb. 10, 1897. F. W. LANCHESTER, 18, Southampton Buildings. **Improvements in Aerial Machines.**

5116. Feb. 25, 1897. F. VOLDERAUER and M. I. F. BRACKEBUSCH, 28, Southampton Buildings, W.C. **Improved Apparatus for Enabling Captive Balloons to Travel along a Fixed Line of Rail.**

5150. Feb. 25, 1897. A. QUENTIN, 111, Hatton Garden, E.C. **Improvements in or Relating to Flying or Soaring Machines.**

5354. Feb. 27, 1897. H. H. LAKE, 45, Southampton Buildings (from EDMOND ANGELOT, France). **An Improved Wheel for Propelling or Steering Ships and Aerostats.**

5580. March 2, 1897. A. J. BOULT, 111, Hatton Garden (from FRITZ JONE, Germany). **Improvements in or Relating to Aerial or Flying Machines or Vessels.**

5591. March 2, 1897. ROBERT SCOTT, 11, Baron Street, Pentonville Road. **Improvements in Regulating the Altitudes of Aerial Bodies.**

5739. March 4, 1897. E. N. MOLESWORTH-HEPWORTH, 5, John Dalton Street, Manchester. **Improvements in Flying Machines.**

6320. March 10, 1897. F. R. SIMMS, 4, South Street, Finsbury. **Improvements in Flying Machines.**

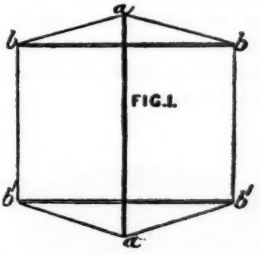
6672. March 13, 1897. A. A. FRIS, 53, Chancery Lane, London. **Apparatus for Aerial Navigation.**

7012. March 17, 1897. RUDOLPH DIESEL, 28, Southampton Buildings, London. **Improvements in Supplying Electrical Energy to Electrically Propelled Aerial Machines and Balloons.**

Patents Published.

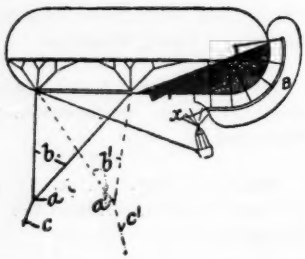
From the *Illustrated Official Journal.*

17,683. September 23, 1895. **Kites.** BADEN-POWELL, B. F. S., Guards' Club, London.



The frame consists essentially of three main poles, two of which *b*, b^1 are arranged at right angles to the third pole *a*, as shown. The poles *b*, b^1 may be attached to the pole *a* by stays, or the frame may be held together by the cambric of the kite, which is provided with pockets to receive the ends of the poles. The fabric of the kite is either hexagonal or rectangular in shape.

18,773. October 7, 1895. **Captive balloons.** RIEDINGER, A., Ausburg, Eisenhammerstrasse 23, Germany.



The balloon is elongated, and one side is kept towards the end by having small balloons or a crescent shaped one B at the other end. The part opposed to the wind is kept inflated by making an opening x in the other end towards the wind and through which it enters. To the holding down ropes c, c^1 are attached pulleys a, a^1 through which pass cords b, b^1 which are attached to other cords as shown.

18,148. October 8, 1895. **Balloons.** COOK, T. D., Glendon, Torquay.

The aerostat is made fish-shaped and is strengthened by a horizontal band C, to which the netting F is attached, so that the aerostat may serve as a parachute in case it bursts. A wooden cane, or similar rigid framework B tends to strengthen the aerostat and distend it in case of collapse. G is the car and H the motor chamber; there are two propellers D at the rear and a rudder E in front of the machine.

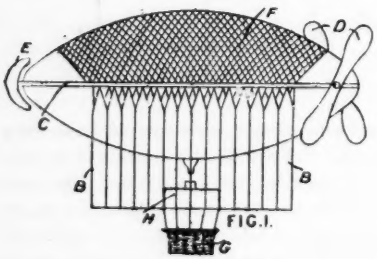


FIG. 1.

19,234. October 14, 1895. **Flying machine.** MIDDLETON, H., 3, Wellesley Villas, Wellington Street, Slough, Buckinghamshire.

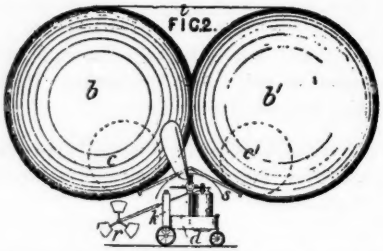


FIG. 2.

The car d and motor are supported by two aerostats b, b^1, which are drawn against each other by an elastic connection i and are thus prevented from becoming flaccid; this is further effected by placing inside, as at c, c^1, or partly surrounding the base of the aerostats smaller vessels, which act as condensers for the steam from the motor, the density of the gas in b, b^1 being controlled by regulating the admission of the steam to the condensers c, c^1 and to the condenser k on the car. The heat from the engine is screened from the aerostats by a shield s which is made large enough to act as a parachute in case the aerostats should be injured, when the car and shield can be readily disconnected from them. Steering is effected by a propeller r which may be worked from the engine at will, and the plane of which may be varied by hand. The apparatus is propelled by wings driven by a motor in the manner described in some of Applicant's prior Specifications, as Specification No. 13,945, A.D. 1888, and the wings may be turned by hand so that they will make a stroke in any desired direction.

19,370. October 15, 1895. **Overhead railways.** JENSEN, P., 77, Chancery Lane, London.—(*Bock E.; Bangkok, Siam.*)

Vehicles on overhead railways are partly supported by balloons. The overhead structure consists of posts M, cross girders d, and ropes or rails S on which the vehicle runs and is guided. The balloon B is in compartments attached to the top of the vehicle V, which is propelled by a suitable motor and provided with guide and running wheels as shown. Sails t are attached to the side of the balloon

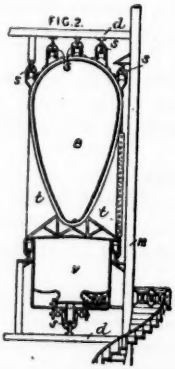


FIG. 2.

French Patents.—Published 1896.

252,919. Jan. 2. PENNINGTON. **Aerial Ship.**

253,175. Jan. 16. BERGER. **Apparatus for Directing Balloons.**

253,705. Feb. 4. TOTH. **Flying Apparatus**

253,831. Feb. 10. LUDVIG. **Dynamic Flying Machine.**

254,194. Feb. 26. GRANIERI. **Dirigible Aerial Apparatus to Replace Balloons.**

254,307. Feb. 27. TRICOTEL and BECOURT. **Improvements in Aerial Apparatus.**

254,222. Feb. 29. FILIPPI. **Aerial Apparatus.**

254,507. March 4. HERVÉ.

255,717. April 21. KOSCH. **Aerial Propeller.**

257,683. June 30. DHEUTTE. **Dirigible Balloon.**

257,853. July 6. DIESEL. **Transmission of Current to Electric Air Ships.**

258,837. Aug. 11. ERAY. **Dirigible Balloon.**

United States Patents.

Quarter ending Dec. 31, 1896. *Nil.*

German Patents.

PUBLISHED 1897. (Class 77.)

89,859. W. DANIELS, Rheinberg.

Method of Causing a Balloon to Rise and Fall by means of an Air Pump and Two Vessels into which the Gas is Compressed or from which it is Exhausted.

89,860. RUDOLPH KOSCH. **Combined Screw Propeller and Aeroplane.** (See English Patent, 1896—9129.)

GRANTED.

91,887. E. EGGERT, Siemon Str. 11, Berlin. **Balloon of Stiff Material with Flexible Balloon Inside.**

"USEFUL DESIGNS."

69,055. G. G. MANDER. **Kite—Tail with Cross-pieces.** (See English Patent, 1896—16,799.)

APPLICATION.

March 10. HERMANN ISRAEL, Schöntelde Str. 15, Dresden. **Flying Machine with Bird like Wings.**

Revue Mensuelle

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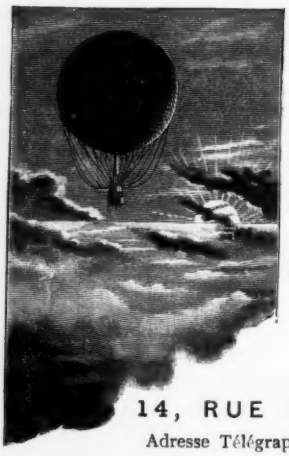

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